

RUNNING HEAD: THE INFLUENCE OF CAFFEINATED ALCOHOL ON GENERAL
AND SEXUAL RISK-TAKING

The influence of caffeinated alcohol on general and sexual risk-taking

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THE INFLUENCE OF CAFFEINATED ALCOHOL ON GENERAL AND SEXUAL RISK-TAKING

Abstract

This lab-based study examined the possible link between caffeinated alcohol (AmED) and general and sexual risk-taking behaviour among UK university students. Subjects (N = 87) were randomly assigned to two conditions; Alcohol Only or AmED. The DOSPERT with additional questions on sexual risk-taking behaviour, Iowa Gambling Task (IGT), and the Balloon Analogue Risk Task (BART) were used to assess the difference between scores of baseline and intervention. Results of the DOSPERT showed that participants in the AmED condition were more likely to take sexual risks, while the IGT showed no difference between conditions as both groups improved their choice of safe decks and response time. The BART also showed no effect of type of drink on score, as both groups were faster at intervention level than at baseline level. AmED participants clicked less often at intervention while Alcohol Only condition clicked more at intervention compared to their baseline scores on the BART. AmED consumers took more sexual risks at intervention level but results showed no further effects of AmED on risk-taking when compared to consuming alcohol without energy drink on other measures. Further research should focus on the application of lab-based studies to examine AmED consumption and risk-taking, while taking individual differences into consideration.

Keywords: alcohol, energy drink, AmED, risk-taking, sexual risk-taking

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The influence of caffeinated alcohol on general and sexual risk-taking

Energy drinks mixed with alcohol have become a popular drink for younger age groups in recent years. The effects on risk-taking of the high doses of caffeine and alcohol combined in these drinks is not well understood. Existing research in this area has relied on self-reporting methods for data collection (Arria & O'Brien, 2011; Martz, Patrick & Schulenberg, 2015; O'Brien et al., 2008; Snipes & Benotsch, 2013; Velasquez, Poulos Latimer & Pasch, 2012). This study aims to build on the existing body of research by comparing baseline and intervention scores of participants given alcohol only, or alcohol mixed with energy drink, taken in a laboratory setting. This will provide further information on the nature of the effect of these drinks on risk-taking behaviour.

Energy drink

Energy drinks have become more popular during recent years and are now widely available in bars, supermarkets, and other establishments. Developed by brands such as RedBull and Monster, the drinks are promoted as improving attention, endurance and giving users a much-needed energy boost. As they are more widely available than ever, with most supermarkets releasing cheaper, own-brand alternatives, researchers have examined the effects of energy drinks and their ingredients on health and performance. Recent studies have found positive links with physical endurance, alertness, psychomotor performance and verbal reasoning (Miller, 2008). However, other researchers claim the main effect on these abilities is due to the caffeine and sugar present in these drinks, not the interaction of the various ingredients advertised as providing the desired benefits. (Miller, 2008; Van den Eynde, Van Baelen, Portzky & Audenaert, 2008).

Mixing energy drink with alcohol

In recent years, energy drinks have become a commonplace non-alcoholic ingredient for cocktails and mix drinks such as Vodka Redbull or Jagerbombs, both popular drinks in bars and clubs. A survey-based study among students of various universities in the UK by Johnson, Alford, Verster and Stewart (2015) found that energy drinks are the most popular choice as an ingredient for a mixed drink or cocktail. The study found that the motives for students to drink alcohol mixed energy drinks (AmED) were the pleasant taste, the social occasion they were taking part in, and the perceived ability to stay awake. Another common reason given by participants was the ability to get drunk on the mixed drink and a perceived reduction in negative effects of alcohol (Johnson, Alford, Verster & Stewart, 2015; Peacock et al., 2015).

Numbers of AmED consumers and their demographics differ according to country, age group or specific study (Breda et al., 2014). Community surveys conducted through landlines or other methods show that the percentage of people drinking AmED in the general population is much lower compared to consumption by specific groups such as college students and teenagers. A large survey on AmED use among high school students in Italy (Scalese et al., 2017) found AmED being consumed by 25%

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of their participants. A study commissioned by the European Food Safety Authority (Zucconi et al., 2013) reported 69% of young adults (aged 18-29) who already consumed energy drinks also mixed these with alcohol. Other studies found that around half of college students have consumed AmED or are regular AmED consumers (Carpenter-Aeby & Barber-Heidal, 2007; Marczinski, 2011, Malinauskas et al., 2007; Snipes & Benotsch, 2013) while O'Brien et al. (2008) reported that a fourth of students in their dataset had consumed AmED in the last month. When asked, college students in the United States reported that they most commonly drunk AmED during specific occasions, such as fraternity initiations and bonding experiences (Johnson, Alford, Verster & Stewart, 2015). Members of this age group could be more prone to the consequences of alcohol consumption as the period they find themselves in is often defined by self-exploration, including personality, sexuality, and practical freedoms such as driving (Evans et al., 2010).

General risk-taking

Concern about the trend of AmED consumption is increasing, as these mix drinks are causing a phenomenon known as 'wide awake drunkenness', the misjudging of one's level of intoxication. The high dosage of caffeine gives the drinker an illusionary feeling of control while being highly intoxicated; this is conducive to making high-risk decisions such as driving home drunk, risky sexual behaviours, and other forms of risk-taking (Arria & O'Brien, 2011; Snipes & Benotsch, 2013).

Ferreira, de Mello, Pompeia and de Souza-Formigani (2006) found similar results concerning AmED consumption, as it seems to inhibit people's ability to accurately gauge their level of intoxication.

Participants in the study reported that their subjective symptoms of intoxication lessened when they consumed AmED. However, their motor coordination and visual reaction time did not differ from those having consumed only alcohol. This demonstrated that though participants in the AmED group felt less intoxicated, their objective level of intoxication was not altered.

An often-researched risk behaviour, associated with AmED consumption, is drunk driving. Driving while intoxicated is responsible for a large proportion of road accidents (Zhao, Zhang & Rong, 2014).

Operating a vehicle while intoxicated is dangerous as alcohol negatively influences perception, vigilance, reaction time, and increases a driver's tendency to swerve while driving (Zhao, Zhang & Rong, 2014). A web-based survey among college students (O'Brien et al., 2008) found that students who were regular AmED consumers were more than twice as likely to allow themselves to be driven by an intoxicated driver, and were more likely to drive while intoxicated than those drinking alcohol without energy drink. Another study by Thombs et al. (2010) found that regular AmED consumers reported a three-fold risk of leaving the bar highly intoxicated, and a four-fold risk of intending to drive home drunk. A similar trend towards unsafe driving was found by Martz, Patrick and Schulenberg (2015), who conducted a study on high school adolescents, which showed a strong correlation between unsafe driving and AmED consumption. This trend remained even when controlling for sociodemographic, academic, social factors, and other substance use. In summary,

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there is a clear, established relationship between AmED and an important form of risk-taking, which is greater than the relationship with alcohol alone.

Other high-risk behaviours associated with AmED have also been identified. AmED consumers are twice as likely to report being injured, hurt or needing medical attention than the general drinking population (O'Brien et al., 2008). And a UK study on motives for drinking AmED reported that those drinking with negative motivation (i.e., drinking alcohol mixed with energy drink to get drunk more easily) consumed alcohol at a younger age, often smoked and experienced more negative consequences when drinking both caffeinated and non-caffeinated alcohol (Johnson, Alford, Verster and Stewart, 2015).

These results are similar to those found on the negative relationship between energy drinks without alcohol, and risk-behaviours. In a study by Miller (2008) frequent energy drink consumers reported drinking and alcohol-related problems over twice as often as non-energy drink users. The participants who regularly consumed energy drink were also three times more likely to smoke, abuse prescription drugs, be in serious physical fights, or to do something risky on a dare.

Sexual Risk-taking

A specific area of risk-taking associated with AmED use is sexual risk-taking. A study by Snipes and Benotsch (2013) found that regular AmED consumers engaged in unprotected sex more often, had sex after having too much to drink or after drug use, and had more sexual partners than participants who did not consume AmED on a regular basis. Another study found that AmED users were more likely to be taken advantage of sexually, independent of the amount of alcohol they consumed (O'Brien et al., 2008). This study also found that men in particular, seem to be influenced by alcohol, concerning the perception of women's sexual interest, with regular AmED consuming men being twice as likely to take advantage of someone sexually.

Similar results were found by Miller (2008) in a study on energy drink without alcohol and risky behaviour. Participants who regularly drank energy drinks were more likely to engage in sexual risk-taking behaviours, such as not using a condom during intercourse, having sex with someone who was drunk or high, and not knowing their sexual partner well.

Current Study

It is known that alcohol intoxication highly influences people's decision-making skills and is linked to risk-behaviours, both general and sexual (Snipes & Benotsch, 2013). The 'wide awake drunkenness' effect could mean that AmED consumers are more inclined to make risky decisions as they experience the inebriation caused by alcohol but feel more convinced of their ability to function properly. What is not fully understood is how the effects of alcohol change when combined with energy drink. In recent years, many studies have focused on the relationship between AmED consumption and risk-taking behaviour. These studies have uncovered valuable insight on the effects of caffeinated alcohol consumption, but have also had some limitations. The majority of available studies used measures that relied solely on self-reports and subjective interpretations of experiences

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and physical states. As much as this method can provide a valuable insight into motives for consuming these drinks or their consequences, it falls short in providing objective information. Purely survey-based studies have not gathered objective baseline and intervention data, participants are counted on to provide information by recalling the amount of alcohol they consumed and their experiences. Retrieving autobiographical memories could lead to a recall bias (Clarke, Fiebig & Gerdtham, 2008), and correctly remembering feelings and experiences while intoxicated may be especially difficult. As previously said, participants in a lab-based study (Ferreira, de Mello, Pompeia & de Souza-Formigani, 2006) reported feeling less impacted by alcohol when it had been combined with energy drink, but their objective intoxication remained unchanged compared to having only alcohol. A participant's recall of their experience with AmED consumption might be influenced by this phenomenon.

Most studies on the relationship between risk-taking and AmED consumption were not lab-based. An extensive database search has only found two lab-based studies on caffeinated alcohol. These two studies are by Heinz, de Wit, Lilje, and Kassel (2013) and Ferreira, de Mello, Pompeia and de Souza-Formigani (2006). Both studied lacked a baseline level, which prevents comparisons of objective differences in risk-taking when sober and after consuming alcohol or alcohol and energy drink. This makes it unclear what the effect of AmED on behaviour is as the data does not exclude the influence of personality on risk-taking.

In addition to the above, the majority of available studies have relied on a single measure to provide information on behavioural changes while under the influence of caffeinated alcohol. Designing studies this way limits the extent of information that can be gathered, as tasks on risk-taking measure behaviour in different ways, or focus on different areas of risk-taking (Buelow & Blaine, 2015).

Although past studies have provided important findings on the relationship between AmED and risk-taking, there is need for more conclusive research into the causal effect of AmED consumption on behaviour. The current study has been designed to address these limitations in the existing literature, by collecting objective data under laboratory conditions. The relationship between AmED consumption and risk-taking will be measured with a repeated measures design, comparing baseline and intervention scores of Alcohol Only and AmED groups. In line with previous studies, it is hypothesized that those in the AmED condition will take more risks than their counterparts in the Alcohol Only condition, and therefore exhibit larger differences between baseline and intervention scores.

Method

Participants

Data for the study was obtained from 87 students at the University of Edinburgh (58 female, 29 male), aged 18-35 ($M = 20.75$, $SD = 3.156$). Participants recruited through the University's recruitment volunteer panel received 1 credit for their participation, other participants received £5.

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Participants were required to sign a consent form before taking part in the experiment detailing the general procedure and the possible risks of participating. Participants were excluded from the study if they had consumed alcohol beforehand or in the case of specific health problems, relevant allergies or the chance of pregnancy. All 87 participants consented, were informed of their rights and remained until the end of the experiment.

Measures

Three tasks were used to assess risky behaviour, the Iowa Gambling Task (IGT), the Balloon Analogue Risk-Taking Task (BART) and the DOSPERT questionnaire, with added questions on sexual risk-taking. These measures were chosen based on their previous usage for measuring risk-taking and their differences in approach (Buelow & Blaine, 2015; Lejuez et. al, 2003).

DOSPERT. The DOSPERT questionnaire was used to assess the difference in self-reported risk-taking. The questionnaire consists of 5 domains, assessed with 40 items on a 5 point Likert Scale (1 = *very unlikely*, 5 = *very likely*). The domains are Recreational, Social, Financial, Ethical and Health and Safety. Recreational risk-taking consists of activities related to sport or outdoor thrill seeking, such as skydiving or swimming in a lake at night time. The Social domain covers decisions such as confronting friends or openly disagreeing with a family member. Financial decisions include gambling and investments, where the Ethics Domain focuses on cheating on a spouse or having to make life-ending decisions. Finally, Health and Safety items include smoking and wearing a seatbelt while driving a vehicle (Weber, Blais & Betz, 2002). To study risky sexual behaviour, 4 additional questions were added to the questionnaire. These questions focused on various aspects of sexual risk-taking (i.e. 'Have sex with someone you hadn't met before that day'). The questionnaire was given to participants with use of the software Qualtrics, and can be found on https://edinburghppls.qualtrics.com/jfe/form/SV_bdbuQjXfAwlkNeJ. Risk-taking on this task was measured by the difference in score, with a higher score during the second session indicating an increase in risk-taking.

IGT. Participants were presented with a computerized version of the IGT that had been programmed for the experiment in E-Prime. Participants were told to maximize their profit as much as possible by the end of the task, which includes 300 trials. Participants could achieve this by choosing 'good decks' over 'bad decks'. It was explained to the participants that each of the four decks had their own reward and punishment, and that it was for them to determine how to use the decks to maximize their gain by the end of the task. These decks were represented by different symbols on a black field (Image 1). Their performance was measured by mean response and the amount of advantageous decks selected over 300 trials (Bechara, Damásio, Damásio & Anderson, 1994). Risk-taking on this task was characterized by an increase in mean response time, together with a decrease in safe deck choices on the second session. The combination of these outcomes would indicate that participants took less time and made riskier decisions at intervention level than at baseline level.

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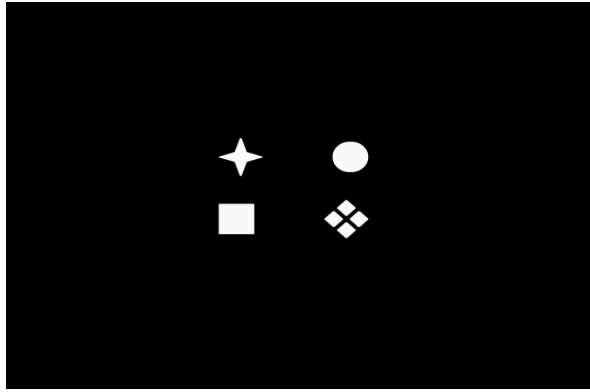


Image 1: main screen of the still of the Iowa Gambling Task

BART. The computerized version of the BART was also administered after the IGT. As with the IGT this task was programmed for the study, and run, in E-Prime. Participants were asked to try to maximise their on-screen monetary reward by pumping up a total of 30 balloons. Participants clicked to pump air into the balloon, and each pump added \$10 to the reward for that balloon (Image 2). Any money banked before the balloon exploded was added to the total score, any money not banked before the balloon exploded was lost. The BART is a recently developed measure of risk-taking behaviour and has demonstrated a high quality of experimental properties. Performance on the BART strongly correlates with sensation-seeking, impulsivity and deficiencies in behavioural constraint (Lejuez et al., 2002). An increase in risk-taking on the BART was indicated by a faster mean response time, and an increase in mean clicks on the second session compared to the first session. This would suggest that participants took less time per trial while increasing the chance of monetary loss.

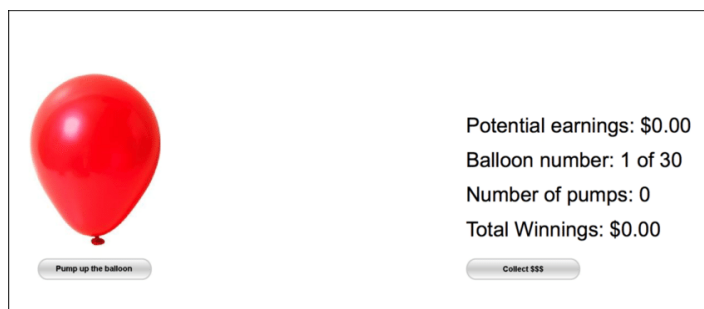


Image 2: main screen of the Balloon Analogue Risk Task

Manipulation

The research design consisted of two conditions, Alcohol Only and AmED, as a means to analyse the effects of caffeine and alcohol. Participants were assigned to the conditions at random and consented to this before taking part in the experiment. The Alcohol Only condition received 25ml of vodka mixed with 125ml of orange juice. The AmED condition also received 25ml of alcohol, mixed with 125ml of energy drink. This maintained the ratio of energy drink to alcohol found in the standard

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mix drink recipe. The amount of alcohol given to participants in both groups was equal to 1 standard UK unit (NHS, 2015).

Data analysis

Distributions of all variables were examined and outliers were removed, a 2.5 standard deviation from the mean cut-off point was used to establish outliers. The two variables of the IGT, mean response time and safe deck choices, had six outliers that required removal from the dataset. The two variables of the BART, mean response time and mean clicks, required five outliers to be removed.

Missing values were examined and variables were adjusted when necessary. The DOSPERT consists of five domains (see: *method*), all of which have eight items from the total questionnaire. Some domains were calculated with less than eight items as some were not answered during one of the two sessions by individual participants, making it impossible to calculate personal differences between the answers given the first and second time. In a very small number of sessions a computer program glitch partly overwrote the data of two participants on the IGT, the data of these participants was not included in the analyses of the IGT. This situation also applied to the data of one participant on the BART, which was also not included in the analyses of BART variables.

To examine the differences between baseline and intervention sessions, 2 x 2 (type of alcohol [AmED, Alcohol Only] x variable [first session, second session]) mixed design ANOVA's were used to assess risk-taking for each variable. Mauchly's test of Sphericity could not be performed for all analyses as there were only two levels in the within-subjects factor (AmED, Alcohol Only). Therefore, sphericity of the data can be assumed. Planned comparisons were executed for all analyses, for two reasons. Firstly, planned comparisons limit the chance of type I error. As this study analyses multiple variables at two levels, type I error would be more likely without a priori testing (Ruxton & Beauchamp, 2008). Secondly, as this study is, to the best of knowledge, the first of its kind, further data on the difference between conditions could prove beneficial.

The syntax, dataset and output of all tests can be found on the Open Science Framework, at <https://osf.io/q8b97/>.

General procedure

The first task participants took part in was the questionnaire, the DOSPERT with added questions on sexual risk-taking, all of which were available through Qualtrics online. After finishing the questionnaire, the IGT would be started up and participants would be informed how to perform the task. They were told that the displayed tokens had both rewards and penalties, with the aim of the task to maximize their final profit by choosing the right tokens. It was not disclosed which tokens were advantageous or disadvantageous. When finishing the IGT, participants were asked about their experience while starting up the BART. The BART was explained as a task in which they were to maximize their profit by pumping the balloon as far as they saw fit. After the first session, participants received their beverage and would remain in the testing area for 30 minutes before starting the tasks

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of the second session (Heinz, de Wit, Lilje & Kassel, 2013; Mitchell, Teigen & Ramchandani, 2014).

The second session was identical to the first, without requiring the detailed explanation of the tasks, unless specifically asked. After finishing the second session, the participants were asked about their overall experience with the study and were debriefed on its' aim, with time for questions. Before departing the testing area, participants were assessed and asked if they felt fit to leave. If they did not, food and water were available. When they left, they were given their monetary reward or were issued their earned credit.

Results

Questionnaire

The first of five domains, Social, showed a significant main effect, $F(1, 85) = 21.33$, $p < 0.001$, $\eta^2 = .201$, but showed no significant difference between conditions, $F(1, 85) = 1.22$, $p = .272$, $\eta^2 = .014$. The pairwise comparisons of difference in scores within conditions showed that both AmED, $F(1, 85) = 16.57$, $p < 0.001$, $\eta^2 = .163$, and Alcohol Only, $F(1, 85) = 6.10$, $p = .015$, $\eta^2 = .067$, have a significant difference in scores between the first and second session, indicating both groups gave a riskier answer on intervention level. The comparisons between groups on both sessions however found no significant differences on both first, $F(1, 85) = .00$, $p = .984$, $\eta^2 = .000$, and second session, $F(1, 85) = .39$, $p = .535$, $\eta^2 = .005$. The plot (Figure 1) illustrates the rise of both groups in scores from the second session compared to the first session. This demonstrates that both alcohol and AmED took more socially-oriented risks at intervention level compared to the baseline but that there is no significant effect of type of drink on social risk-taking.

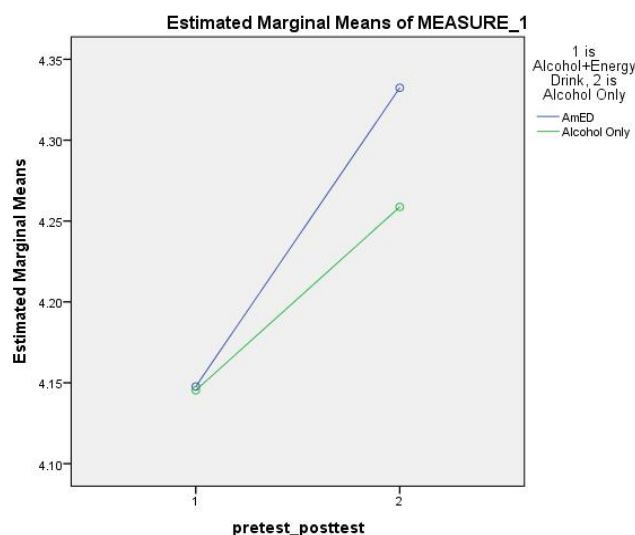


Figure 1: plot of Social mean scores on the first and second session by condition

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The second domain, Financial, showed no significant effects for both the main, $F(1, 85) = 1.55, p = .217, \eta^2 = .018$, and interaction effect, $F(1, 85) = .19, p = .665, \eta^2 = .002$.

Planned comparisons found no significance when comparing the mean scores of the first and second session for the AmED condition, $F(1, 85) = 1.42, p = .236, \eta^2 = .016$, and this was similar for Alcohol Only, $F(1, 85) = 3.24, p = .071, \eta^2 = .004$. When comparing performance of the two sessions between the condition groups, both the first session, $F(1, 85) = .68, p = .410, \eta^2 = .008$, and the second session, $F(1, 85) = 1.05, p = .308, \eta^2 = .012$, showed no significant differences in scores between AmED and Alcohol Only. These results indicate that there was no increase in financial risk-taking after consuming either Alcohol Only or AmED, and that there is no relationship between the type of drink and response on the Financial domain of the DOSPERT.

The analysis on the Recreational domain showed a marginal significant effect for the main effect of time, $F(1, 85) = 3.08, p = .083, \eta^2 = .035$, and no significant interaction effect, $F(1, 85) = .52, p = .471, \eta^2 = .006$, indicating a moderate difference over time but no difference in scores by group conditions. The planned comparisons within groups displayed a marginal difference for the AmED condition between scores on session 1 and session 2, $F(1, 85) = 3.11, p = .081, \eta^2 = .035$, while scores by the Alcohol Only condition were not significantly different for different sessions, $F(1, 85) = .52, p = .471, \eta^2 = .006$. There was no significant difference in performance between the groups, not at baseline, $F(1, 85) = .03, p = .873, \eta^2 = .000$, or at intervention level, $F(1, 85) = .16, p = .693, \eta^2 = .002$. These findings suggest that there was no relationship between condition and recreational risk-taking, as the groups differences were not substantial enough to demonstrate the effect of a type of drink on risk-taking on the Recreational domain.

An analyses of Ethical risk-taking showed a significant main effect, $F(1, 85) = 4.50, p = .037, \eta^2 = .050$, but failed to produce a significant interaction effect, $F(1, 85) = .30, p = .586, \eta^2 = .004$. Pairwise comparisons showed a marginal difference in scores on the first and second session for the AmED condition, $F(1, 85) = 3.60, p = .061, \eta^2 = .041$, but no difference for the Alcohol Only condition, $F(1, 85) = 1.23, p = .271, \eta^2 = .014$. The groups also did not significantly differ from one another at baseline, $F(1, 85) = .742, p = .392, \eta^2 = .009$, and intervention level, $F(1, 85) = 1.06, p = .306, \eta^2 = .012$. Similar to recreational risk-taking, the findings suggest that there was no relationship between type of drink and ethical risk-taking, as the groups' differences were not sufficient in demonstrating the effect of type of drink on risk-taking on the Recreational domain.

The last of the original DOSPERT domains, Health and Safety, showed no significant results for either the main time effect, $F(1, 85) = .47, p = .493, \eta^2 = .006$, or the interaction effect, $F(1, 85) = 1.49, p = .225, \eta^2 = .017$. Similar results were found using planned comparisons, AmED had no difference in scores between the first and second session, $F(1, 85) = 1.85, p = .178, \eta^2 = .021$, nor did Alcohol Only, $F(1, 85) = .14, p = .709, \eta^2 = .002$. Comparisons between groups on baseline and intervention level resulted in non-significant differences on both the first session, $F(1, 85) = 1.396, p = .241, \eta^2 = .016$, and second session, $F(1, 85) = .42, p = .561, \eta^2 = .005$. This indicates that the

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AmED and Alcohol Only participants did not differ in risk-taking when sober or after consuming their drink, nor did they differ when the groups were compared to each other.

The analysis of Sexual risk-taking showed a significant main effect, $F(1, 85) = 5.08, p = .027, \eta^2 = .056$, and a marginal significance regarding the condition effect, $F(1, 85) = 3.30, p = .073, \eta^2 = .037$. The pairwise comparisons of scores on sessions 1 and 2 within the condition groups showed a significant difference between the mean scores of sessions 1 and 2 for the AmED condition, $F(1, 85) = 8.38, p = .005, \eta^2 = .09$, as participants responses indicated they would take more sexual risks at intervention level than at baseline level. This effect was not found in the Alcohol Only condition, as the difference in scores for sessions 1 and 2 was not significantly different, $F(1, 85) = .09, p = .759, \eta^2 = .001$. When comparing the means for sessions between groups, there was no significant difference found between group means on session 1, $F(1, 85) = .07, p = .795, \eta^2 = .001$, and session 2, $F(1, 85) = .39, p = .535, \eta^2 = .001$. The plot (Figure 2) shows that the AmED condition has a lower mean score during the first session but has the highest mean score of both groups on the second session, though all scores in the plot are rather close to one another. These results indicate that there was a marginally significant effect of the type of drink on sexual risk-taking, with AmED participants taking more risk after consuming their drink compared to being sober, though responses were not significantly different from Alcohol Only when comparing scores per session.

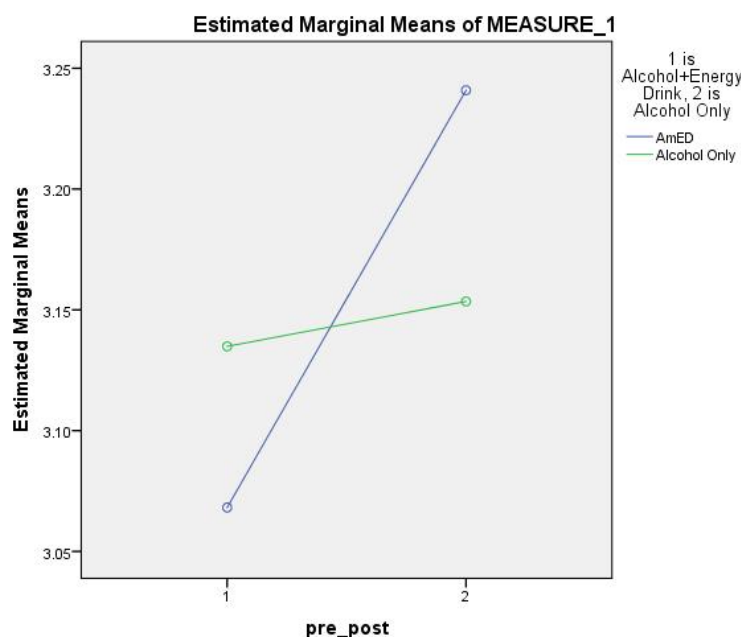


Figure 2: Sexual mean scores on first and session by condition

Iowa Gambling Task

The difference between mean response time per trial on sessions one and two was examined first. The test of within subjects effects showed a significant main effect, $F(1, 77) = 23.15, p < 0.001$,

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$\eta^2 = .231$, but no significant interaction effect, $F(1, 77) = .29, p = .589, \eta^2 = .004$. This indicates a significant effect of time on the two measured variables but this is not influenced by condition. The planned comparison of the difference in scores within conditions showed that the AmED condition had a significantly faster response time after the intervention than during the first session, $F(1, 77) = 9.23, p = .003, \eta^2 = .107$, but the difference in average score was smaller than the difference between the mean scores on session 1 and 2 for Alcohol Only, $F(1, 77) = 14.15, p < .001, \eta^2 = .155$. When comparing the mean scores between the two groups per session, the difference in mean response time between groups on both session 1, $F(1, 77) = .95, p = .332, \eta^2 = .012$, and session 2, $F(1, 77) = 2.29, p = .134, \eta^2 = .029$, were not significant. The findings indicate that there was no effect between type of drink and mean response time, as both groups responded faster at intervention level compared to baseline level.

Secondly, the proportion of safe deck choices was analysed by means of a 2 x 2 (type of alcohol [AmED, Alcohol Only] x number of safe deck choices [first session, second session]) analysis of variance (ANOVA) with repeated measures. The main effect of time proved significant, $F(1, 77) = 35.47, p < .001, \eta^2 = .315$, but the interaction effect was not, $F(1, 77) = 1.63, p = .205, \eta^2 = .021$. The simple effects showed a significant rise in safe choices between the first and second session for the Alcohol Only condition, $F(1, 77) = 25.84, p < .001, \eta^2 = .251$, and the AmED condition, $F(1, 77) = 11.08, p = .001, \eta^2 = .126$, with Alcohol Only having the larger difference in means between session 1 ($M=180.64, SD= 5.62$) and session 2 ($M= 215.44, SD= 8.715$). This indicates that participants in the AmED condition did not recognize the safe choices as quickly as the participants in the Alcohol Only condition did. The pairwise comparisons between group means on sessions 1 and 2 found no significant difference on the first session, $F(1, 77) = 1.25, p = .267, \eta^2 = .016$, but a marginally significant difference between the two groups on session 2, $F(1, 77) = 2.98, p = .088, \eta^2 = .037$. This, with visual description in the plot (Figure 3), indicates that the groups were not significantly different in the number of times they chose safe decks during the baseline testing but did differ in the amount of safe decks chosen at intervention level, with the AmED condition choosing safe options less often. In sum, the type of drink did not significantly affect the amount of safe choices, both groups improved their safe choices on the second time with the Alcohol Only condition making just slightly more safe choices than the AmED condition did.

Risk-taking on the IGT as a whole is characterized by a combination of a faster response time and lower number of safe deck choices. Both conditions were faster at intervention level but both chose safe deck options more often too. It can therefore be said that AmED consumption did not lead to an increase in risk-taking behaviour on this task.

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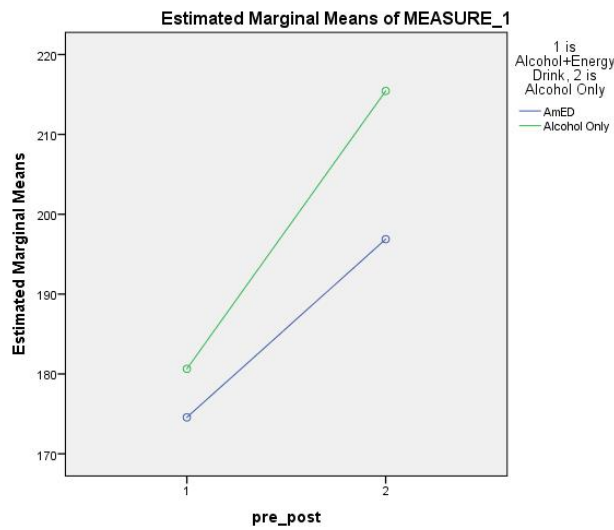


Figure 3: IGT Safe Deck mean scores on first and session by condition

Balloon Analogue Risk-taking Task

The analysis on the difference in mean response time between sessions one and two showed a significant result for the main effect of time, $F(1, 79) = 67.92, p < .001, \eta^2 = .462$, but no significant main effect was found for the group conditions, $F(1, 79) = .514, p = .476, \eta^2 = .006$. The comparisons showed a significant difference when comparing the scores on the first and second session within both groups, indicating that both AmED, $F(1, 79) = 27.97, p < .001, \eta^2 = .261$, and Alcohol Only, $F(1, 79) = 40.63, p < .001, \eta^2 = .340$, had faster response times after intervention. The analyses on the differences between groups on the first or second session found no difference between AmED and Alcohol Only on the first session, $F(1, 79) = 2.73, p = .102, \eta^2 = .033$, but did show a significant difference between the scores on session 2, after intervention, $F(1, 79) = 4.89, p = .03, \eta^2 = .058$. The findings indicate that both groups individually were significantly faster after consuming alcohol or AmED, and their combined mean response time on the second session was faster compared to the first session. However, it could not be concluded that the type of drink affected mean response time on the BART.

The second measured variable was the mean clicks per trial, of which it was hypothesised that more clicks were indicative of risky decision-making. To assess this, a 2 x 2 (type of alcohol [AmED, Alcohol Only] x mean clicks per trial [first session, second session]) analysis of variance (ANOVA) with repeated measures was used. Both the main effect of the analysis, $F(1, 79) = .37, p = .545, \eta^2 = .005$, and the effect of interaction were not significant, $F(1, 79) = 2.67, p = .107, \eta^2 = .033$. Planned comparisons found a non-significant difference between scores on session 1 and 2 for both AmED, $F(1, 79) = 2.48, p = .119, \eta^2 = .03$, and for Alcohol Only conditions, $F(1, 79) = .53, p = .107, \eta^2 = .007$, with the AmED condition displaying a lower average on the second session compared to the

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first. By contrast, the average clicks for Alcohol Only increased during the second session. The difference between groups on the first session, $F(1, 79) = .37, p = .547, \eta^2 = .005$, and the second session, $F(1, 79) = .32, p = .566, \eta^2 = .004$, are also not significant. The plot (Figure 4) shows a cross-over in mean scores as the AmED condition seemed to click less after the intervention ($M = 21.30, SD = 5.86$) than during the baseline trials ($M = 22.32, SD = 5.48$) while participants in Alcohol Only had a higher average number of clicks per trial on the second session ($M = 22.06, SD = 6.02$) compared to the first ($M = 21.59, SD = 5.44$). The cross-over can account for the non-significance of the main effect but the difference is also not substantial enough to conclude a significant interaction between condition and scores (VanderWeele & Knol, 2014). These findings show that the Alcohol Only and AmED conditions had contrasting performances, with AmED clicking less often and Alcohol Only more often at intervention level, but that this was insufficient to conclude that a specific type of drink affected the mean number of clicks per trial.

As previously mentioned, risk-taking on the BART consists of a faster response speed, while also clicking more often to pump the balloon per trial. The results show a faster mean response speed but this is not influenced by the type of drink participants have consumed, nor was there an effect of condition on mean clicks per trial. It can therefore be said that AmED consumption did not lead to an increase their risk-taking on the BART.

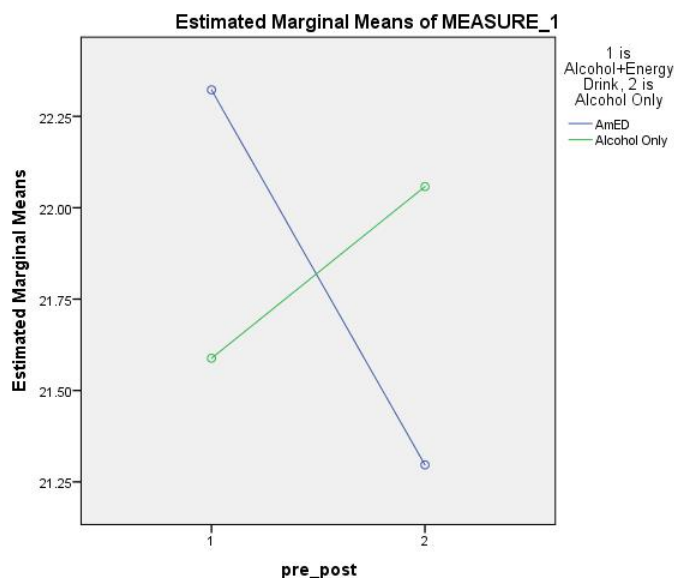


Figure 4: BART Mean Click scores on first and second session by condition

Discussion

This study examined the relationship between AmED consumption and general and sexual risk-taking among UK students. Designed as lab-based experiment, this study is the first of its kind and provides new insight into the effects of AmED on behaviour. In general, results of the three tasks

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showed no effect of condition on scores, except for a marginally significant effect between AmED and risky sexual behaviour.

The first measure of the study, the DOSPERT, examines five domains of risk-taking behaviours. To examine sexual risk-taking behaviour an additional domain was created. No relationship between AmED and increased risk-taking was found across any of the original domains, even though participants in the AmED condition generally showed an increase in risk-taking at the intervention level compared to their baseline scores. This trend was also found for the Alcohol Only condition but occurred less often than it did for the AmED group. The additional domain, sexual risk-taking did have a marginally significant interaction effect, with AmED participants taking more risks at intervention level than at baseline level. Therefore, AmED was not demonstrated to have a greater impact on risk-taking behaviour than Alcohol Only, except for sexual risk-taking. The domains in which AmED participants did not show an increase in risk-taking behaviour were the Financial, and Healthy and Safety domains. The lack of difference in scores could be due to the type of questions in these domains. For example, questions about financial risk-taking featured hypothetical situations in which participants would be asked whether they would be willing to gamble their weekly or monthly income at races, or were asked about the percentage of their income they would be willing to invest in a speculative stock. The mean age of participants in this study was 20 years old, thus increasing the likelihood that most students have not been in a relatable situation to those described in the questionnaire. Furthermore, Hanoch, Johnson and Wilke (2006) used the DOSPERT as a method to establish whether risk-taking could be considered a stable trait and found that participants who took risks in one particular domain would not necessarily take high risks on another. The researchers implied that risk-taking was determined by a gain/loss framework, in which perceived benefit outweighs perceived risk. As the proposed situations by the questionnaire might be unlikely for their age group, the perceived benefit of such an action might seem less than it would to a participant from a different age group.

The second measure, the IGT, measured risk-taking by response time and the amount of times a safe choice was made, with a bad deck choice indicating increased risk-taking. Where measures such as the DOSPERT and BART displayed an increase in risk-taking, the IGT displayed the opposite. Participants in both groups were faster and chose the safe options more often after the intervention. An explanation for this could be the learning component of the IGT. The task requires participants to recognize the difference in decks and apply this knowledge to gain more profit. As participants took part in the task twice they had prior experience with choosing decks in the task and were able to choose profitable decks more easily. Buelow and Suhr (2009) emphasized that the IGT did not take a possible learning effect into consideration when testing healthy participants. Healthy participants in the study could still improve their performance months later, while clinical populations could not. Similar findings were reported by Xu, Korczykowski, Zhu, and Rao (2013), who found the IGT to have a low test-retest reliability when compared to other tasks including the BART. Previous

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studies and the findings of the current study suggest that the IGT may therefore not be suitable to measure risk-taking in a setting with repeated measures.

The BART is a commonly used measure to analyse risk-taking behaviour by means of a gain/loss framework in a randomized setting. The learning effect of the BART in this study appeared to be limited, as participants from both groups were faster during the second session but did not differ in the number of times they clicked to pump the balloon when comparing the first and second session of the task. These findings align with others concerning the test-retest suitability of the BART (Veling & Bijleveld, 2015; Weafer, Baggott & de Wit, 2013; White, Luejuez & de Wit, 2008; Zedelius, Veling & Aarts, 2012).

Though participants in both groups showed increased risk-taking behaviour after consuming alcohol or AmED no main effect of condition on risk-taking behaviour was found. These findings indicate that AmED does not lead to higher levels of risk-taking than alcohol without energy drink. These findings are in contrast with previous studies, which showed a relationship between AmED consumption and risky behaviours such as drinking to high levels of intoxication (Thombs et al., 2010), driving under influence (Martz, Patrick & Schulenberg, 2015; O'Brien et al., 2008; Thombs et al., 2010), having unprotected sex (Snipes & Benotsch, 2013), wrongly interpreting someone's sexual interest (O'Brien et al., 2008), and needing medical attention for injuries (O'Brien et al., 2008). As previously mentioned, these studies were based on self-reports and surveys taken by AmED consumers, and rely heavily on their subjective experience. Designs like these can be prone to bias and problems concerning recall when having to remember an event that happened in the last 30 days, which was the cut-off point for most surveys. This study did not rely on self-reports and behaviour was measured by the objective difference in answers given during the first and second session. The difference in design could account for the contrasting findings.

However, self-report measures have the benefit of being able to take personality into account. As this study did not find a relationship between AmED consumption and risk-taking directly, personality may have a larger role in AmED consumption than previously thought. Various studies have claimed that AmED consumption may be part of a personality trait and could be symptomatic instead of causal to risk-taking (Arria et al., 2011; Miller, 2008; Verster et al., 2016; Velasquez, Poulos Latimer & Pasch, 2012).

Benefits

The current findings provide further insight to the effects of AmED consumption on risk-taking behaviour. The design of the study allowed the comparison of risk-taking tendencies when sober and after consumption of AmED, while simultaneously comparing the scores on both levels with a condition known to impair decision-making, Alcohol Only. As this, to the best of knowledge, has not been done before it is one of the first studies to provide controlled, lab-based data on risk-taking before and after AmED consumption. As the study focused on the difference in scores between the baseline and intervention levels, confounding effects such as personality were excluded. This

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study adds to existing work by examining the effect of AmED on risk-taking with three established measures, the BART, IGT and the DOSPERT. Using three measures made it possible to explore various risk assessment methods as it has been found that the BART and IGT measure risk-behaviour differently (Buelow and Blaine, 2015). This study could contribute to future research as it demonstrated the workings of these measures in a test-retest setting, and might influence the choice of measure in a future study.

Limitations

This lab-based study is the first of its kind to test the effects of AmED on risk-taking behaviour, but the study also had its limitations. Only a small dosage of AmED and alcohol could be given to participants. The AmED condition consumed a beverage consisting of 37.5mg caffeine, 6 grams of sugar and 25ml of 40% Vodka. These amounts are only about half of the standard amount when energy drink and alcohol are mixed together. This amount may not have been sufficient in creating the desired effect as studies reported regular AmED users consuming multiple drinks per evening. Repeated consumption of alcohol and caffeine creates a resistance higher than non-regular alcohol and caffeine consumers would have. Secondly, participants showed a faster response time at intervention level for both the BART and IGT. A placebo group would be beneficial to determining the learning effect for both these tasks and would make it easier to distinguish performance between groups. A placebo condition was not included in this study as the sample size was not large enough to include this condition without risking statistical power.

Directions for future research

Further research on the topic would benefit from focusing on the effect of personality on AmED consumption. It could provide further insight into what type of personality is more likely to lead to AmED consumption, and how this relates to other risk-taking behaviours. The DOSPERT and BART have been useful measures in a repeated measures study and could be used in research with a similar setting. However, the IGT showed a large learning effect and should not be included as a measure for a repeated measures design, unless a placebo group could account for the learning effect of the task. It would also be beneficial to determine the dosage of alcohol according to the Blood Alcohol Concentration (BAC) of participants. By adjusting the amount of alcohol given to personal factors such as gender, weight, and age, a similar level of intoxication can be achieved for all participants. Other recommendations include adopting sample size to achieve more statistical power, adding a placebo condition to determine the learning effect of the measures used. These recommendations would narrow the gap between real-life behaviour and behaviour in the laboratory and could be beneficial to studying the effect of AmED on risk-taking behaviour.

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